Supplementary Materials

Life's Essential 8 -- Updating and Enhancing the American Heart Association's Construct of Cardiovascular Health: A Presidential Advisory From the American Heart Association

Appendix 1: Assessing Diet for Quantifying Cardiovascular Health

The Dietary Approaches to Stop Hypertension (DASH) diet significantly reduced blood pressure among individuals who are normotensive and hypertensive in efficacy studies[1].[1] Across various populations, adherence to the DASH-style eating pattern is associated with lower inflammation burden,[2-4] lower risk of chronic diseases,[5] CHD and stroke in women in middle age,[6] lower risk of CVD in adults,[7] and in those with chronic kidney disease.[8]

For the purposes of measuring CVH *at the population level*, the DASH-style diet score[9, 10] will be used to evaluate diet within Life's Essential 8 (**Table A**) for adult and pediatric populations. The score has 8 components (**Table B**): high intake of fruits, vegetable, nuts and legumes, whole grains, low fat dairy, and low intake of sodium, red and processed meats, and sweetened beverages. The range of the overall score is 8 to 40. Of note, there is a discrepancy between the DASH-style diet and the AHA's 2019 dietary guideline with regards to low-fat dairy. After deliberation, low-fat dairy was included by the writing group for this document given our focus on CVH across the life course. In childhood, calcium is needed for growth and bone health and low-fat dairy is an important source of dietary calcium.[11] In monitoring population-level trends and for research, it may be useful to scale the intakes to the recommended mean calories (as suggested by the USDA Dietary Guidelines for Americans, 2020-2025) appropriate to the age range and sex of the individuals or populations being assessed. For generating quintiles of the DASH diet score, the most recent or most relevant NHANES data should be used based on the question being addressed.

To assess and monitor *individual level* CVH, the Mediterranean Eating Pattern for Americans "MEPA" (**Table C**) can be used across healthcare settings in adult and pediatric populations to identify opportunities for dietary counseling that promotes cardiovascular health.[12] The MEPA is a DASH-style pattern and there is substantial overlap in their components. It was adapted from the Mediterranean Diet Adherence Screener (MEDAS)[13] another tool with high theoretical and practice-based validity. After a recent rigorous review of diet screening tools,[14] there was no explicit screener termed "DASH" that has been created for clinical settings and validated. However, the MEPA emerged as a valid and feasible method for diet screening after consideration of theory- and practice-based criteria.[14] This tool is brief (16 questions), assesses diet quality, has criterion and predictive validity, and can be administered remotely or in-person using multiple modalities (computer, mobile app, or paper) across diverse populations. The range of the overall score is 0 to 16. The writing group urges clinicians and health systems to adopt this tool, and researchers to assess its implementation, in order to standardize and advance dietary assessment in clinical settings. The writing group also encourages clinicians to assess the amount of sugar-sweetened beverage intake as an adjunct to this tool.

Both of these tools can be aligned with the Healthy Eating Index[15] in order to allow for cross-walking of data from the individual to the population level, if desired. The writing group acknowledges that there is no ideal means for assessing all eating patterns at the individual or population level. The proposed tools represent the best available tools in our judgment. These are likely to evolve over time. The writing group emphasizes that it is critical for clinicians and health systems to implement routine assessment of eating patterns in order to monitor health more broadly and intervene more effectively. As eating patterns evolve over time, it may also be useful to recalibrate population-level scoring to ensure that optimal eating patterns are being appropriately represented.

The writing group acknowledges that there is limited data on dietary assessment instruments and their implementation in clinical and population settings. We urge further research in this area in all settings and adjustment of the dietary metrics as new tools and data become available. We have selected the current approach in order to use the best available tools and to push the field to further innovation. TSome of the issues and limitations are more magnified in dietary assessment in children, especially younger than 6 years old. These are discussed in greater detail in Appendix 2, below.

Table A. Population level measurement of diet in the "Essential 8" for CVH

Domain	CVH Metric	Method of Measurement	Quantification of CVH Metric – Adults (≥20 y)	Quantification of CVH Metric – Children* (2 to 19 y)
Health Behaviors	Diet	**Measurement**: Self-reported daily intake of a DASH-style eating pattern **Example tools for measurement:** DASH diet score[9, 10] (populations); Mediterranean Eating Pattern for Americans[12] (individuals)	Quantiles of DASH-style diet adherence or HEI-2015 (population) **Scoring (Population):** <u>Points</u> <u>Quantile</u> 100 ≥95^{th} %ile (top/ideal diet) 80 75^{th} – 94^{th} %ile 50 50^{th} – 74^{th} %ile 25 25^{th} – 49^{th} %ile 0 1^{st} – 24^{th} %ile (bottom/least ideal quartile) **Scoring (Individual):** <u>Points</u> <u>MEPA Score (points)</u> 100 15 -- 16 80 12 -- 14 50 8 -- 11 25 4 -- 7 0 0 -- 3	Quantiles of DASH-style diet adherence or HEI-2015 (population), or MEPA (individuals)*; ages 2-19 years (see supplementary material for younger ages) **Scoring (Population):** <u>Points</u> <u>Quantile</u> 100 ≥95^{th} %ile (top/ideal diet) 80 75^{th} – 94^{th} %ile 50 50^{th} – 74^{th} %ile 25 25^{th} – 49^{th} %ile 0 1^{st} – 24^{th} %ile (bottom/least ideal quartile) **Scoring (Individual):** <u>Points</u> <u>MEPA Score (points)</u> 100 9 -- 10 80 7 -- 8 50 5 -- 6 25 3 -- 4 0 0 -- 2

*Cannot meet these metrics until solid foods are being consumed

Notes on implementation:
Diet: See Supplementary Material Appendix 1. For adults and children, a score of 100 points for the CVH diet metric should be assigned for the top (95^{th} %ile) or a score of 15-16 on the MEPA (for individuals) or for those in the ≥95^{th} %ile on the DASH score or Healthy Eating Index (HEI) 2015 (for populations). The 75^{th} – 94^{th} %ile should be assigned 80 points, given that there is likely improvement that can be made even among those in this top quartile. For individuals, the MEPA points are stratified for the 100 point scoring system approximately by quantiles. In children, a modified MEPA is suggested based on age-appropriate foods. The writing group recognizes that the quantiles may need to be adjusted or recalibrated at intervals with population shifts in eating patterns. In children, the scoring applies only once solid foods are being consumed. For now, the reference population for quantiles of HEI or DASH score should be the NHANES sample from 2015-2018. The writing group acknowledges that this may need to change or be updated over time. Clinicians should use judgment in assigning points for culturally-contextual healthy diets. For additional notes on scoring in children, see Supplementary Materials, Appendix 2.

Table B. Scoring Criteria for the DASH-style diet score

Component	Foods (NHANES 24 hour recall)	Scoring Criteria	Note
Fruits	All fruits and fruit juices	Quintile 1: 1 point Quintile 2: 2 points Quintile 3: 3 points Quintile 4: 4 points Quintile 5: 5 points	Higher score represents more ideal intake Quintile 1 is lowest consumption and Quintile 5 is highest consumption
Vegetables	All vegetables except potatoes and legumes		
Nuts and Legumes	Nuts and peanut butter, dried beans, peas, tofu		
Whole Grains	Brown rice, dark breads, cooked cereal, whole grain cereal, other grains, popcorn, wheat germ, bran		
Low-fat Dairy	Skim milk, yogurt, cottage cheese		
Sodium	Sum of sodium content of all foods reported as consumed	Quintile 1: 5 points Quintile 2: 4 points Quintile 3: 3 points Quintile 4: 2 points Quintile 5: 1 point	Reverse scoring as higher quintiles represent less ideal intake Quintile 1 is lowest consumption and Quintile 5 is highest consumption
Red and Processed Meats	Beef, pork, lamb, deli meats, organ meats, hot dogs, bacon		
Sweetened beverages	Carbonated and noncarbonated sweetened beverages		

Note: The DASH diet score is assessed and points scored using the methods of Fung et al.[137]. Quintiles of point score should be assigned using the most recent or most relevant NHANES data, appropriate to the question being addressed.

Table C. Scoring criteria for the Mediterranean Eating Pattern for Americans [12]

Screener Item	Question	Scoring Criteria	Score
Olive oil	How much olive oil do you consume per day (including that used in frying, meals eaten away from home, salads, etc)?	≥2 servings of olive oil per day	1: If scoring condition met 0: If scoring condition not met (Range: 0-16)
Green leafy vegetables	How many servings of green leafy vegetables do you consume per day?	≥7 servings of green leafy vegetables per week	
Other vegetables	How many servings of other vegetables do you consume per day?	≥2 servings of other vegetables per day	
Berries	How many servings of berries do you consume per week?	≥2 servings of berries per week	
Other fruit	How many servings of other fruit do you consume per week?	≥1 serving of other fruit per day	
Meat	How many servings of red meat, hamburger, bacon or sausage do you consume per week?	≤3 servings of red meat, hamburger, bacon or sausage per week	
Fish	How many servings of fish or shellfish/seafood do you consume per week?	≥1 serving of fish per week	
Chicken	How many servings of chicken do you consume per week?	≤5 servings of chicken per week	
Cheese	How many servings of full fat or regular cheese or cream cheese do you consume per week?	≤4 servings of full fat or regular cheese or cream cheese per week	
Butter/cream	How many servings of butter or cream do you consume per week?	≤5 servings of butter or cream per week	
Beans	How many servings of beans do you consume per week?	≥3 servings of beans per week	
Whole grains	How many servings of whole grains do you consume per day?	≥3 servings of whole grains per day	
Sweets and Pastries	How many servings of commercial sweets, candy bars, pastries, cookies, or cakes do you consume per week?	≤4 servings of commercial sweets, candy bars, pastries, cookies, or cakes per week	
Nuts	How many servings of nuts do you consume per week?	≥4 servings of nuts per week	
Fast food	How many times per week do you consume meals from fast food restaurants?	≤ 1 meal at a fast food restaurant per week	
Alcohol	How much alcohol do you drink per week?	>0 or ≤2 servings of alcohol per day for men and >0 or ≤1 servings of alcohol per day for women	

Appendix 2: Special Considerations for Assessment of Cardiovascular Health in Children

As reviewed above (Section II of main manuscript), the CVH construct is widely applicable and powerfully predicts health outcomes, even when applied in childhood.[16-20] CVH provides a clear and consistent message across generations (parents and children) and life course stages, which reinforces education for the family and simplifies evaluation and counseling for the clinician. CVH is especially well suited to pediatrics conceptually, given its focus on primordial prevention of risk factor development. Its global nature is also useful to soften the focus on any single suboptimal metric—commonly BMI—and put it in the context of more directly modifiable health behaviors, while also connecting it to other well-recognized CVD risk factors (such as BP) to enhance motivation for family lifestyle change. Thus, there are many potential benefits to assessing CVH across childhood.[21]

In the original 2010 manuscript defining the construct of CVH, definitions and classifications were provided down to different minimum childhood ages for different metrics, primarily driven by availability of NHANES data. Since that time there have been many efforts and calls to assess and promote CVH from the very beginning of life, including at ages younger than addressed by the previous CVH definition.[22-24] For the current CVH update, we considered whether and how to apply CVH down to the youngest ages, and in particular ages <6 years old. To address this issue, we asked two questions for each developmental stage: (1) Is total CVH and/or a given metric relevant for health outcomes at this age/stage? The answer to this question should inform its use for clinical counseling, population monitoring, and research. (2) Are the CVH metrics well measured and classified in routine practice as standard of care at this age/stage? This affects operationally when a CVH score could be formally calculated in clinical practice. It should be noted that the answers to #1 and #2 may differ, partly due to competing priorities in clinical visits, and because clinical guidelines for measurement consider factors beyond relevance to health outcomes, such as the prevalence of abnormal levels in the population, which is generally much lower in childhood, and evidence for benefits of screening, which is an ongoing challenge for pediatrics given the long latency to outcomes.

(1) CVH for Clinical Counseling, Population Monitoring, and Research—Relevance of CVH.

Numerous studies have shown that total CVH in childhood, starting at least around age 8 years (the youngest age investigated), is associated with subclinical CVD in middle age.[16-20] Moreover, a recent study examined several individual metrics (BMI, BP, total cholesterol, triglycerides, and smoking) at ages 3-19 years among 38,589 participants with mean follow-up of 35 years, documenting that an unweighted average of the metric z-scores—conceptually similar to a total CVH score—was strongly associated with adjusted hazards for fatal and nonfatal CVD events before age 65 years.[25] There was no difference in this finding when the age at measurement was 3-11 years versus 12-19 years, suggesting the relevance of CVH for long-term CVD event risk down to age 3 years. Under age 3 years, data on future CVD events are lacking, but data for short- to medium-term health outcomes (including tracking of metrics into adolescence and adulthood) are sufficiently robust that diet, physical activity (screen time and active play), sleep, secondhand smoke exposure, and body weight are the subject of repeated attention and counseling at routine well-child visits per the American Academy of Pediatrics (AAP) Bright Futures guidelines.[26] BP (if accurately measured),[27] lipids, and glycemia are physiologically meaningful at all ages but have been less well studied in children <2-3 years old in the general population (i.e., outside of certain conditions such as kidney disease for BP, type 1 diabetes mellitus for glycemia, and genetic dyslipidemia for lipids), so their ability to stratify long-term cardiometabolic risk across a spectrum of levels is less certain in this age group, though they could still be introduced conceptually to parents as part of the motivation for establishing and maintaining healthful habits from a young age. In summary, the evidence supports the relevance of the CVH concept down to the youngest ages. This justifies consistent messaging about CVH across developmental stages in clinical practice, monitoring of pediatric CVH at the population level, and pursuit of future research using—and ideally optimizing the use of—the CVH concept in children of all ages (see Research Gaps and Future Directions, Section X). While awaiting further research and definitive, evidence-based scoring of CVH down to the youngest ages, researchers and public health officials may need to adapt the suggested scoring approach (below) to the available dataset and specific goals of the CVH assessment.

<u>(2) Formal Calculation and Tracking of CVH Scores in Clinical Practice—Routine Measurement and Classification of CVH Metrics</u>. Guidelines for routine clinical screening include assessment of CVH behaviors, weight and length down to infancy,[26] blood pressure starting at age 3 years[27] (younger if risk factors for hypertension), lipids once at age 9-11 and again 17-21 years[28] (younger if risk factors for dyslipidemia), and glycemia only in the presence of risk factors for diabetes.[29] Thus, in theory CVH scoring could be done using routine measurements of a subset of 5 metrics (4 behaviors + BMI) at all ages, 6 metrics (adding BP) at age 3-8, and 6-8 metrics at age 9-10+ depending on specific age and comorbid risk factors. However, some measurements (e.g., BP) may be subject to more error at the youngest ages. Further, the challenge of assigning thresholds and corresponding point values to various levels of metrics is compounded at the youngest ages where data are more sparse on long-term outcomes. Therefore, we suggest that for pediatric clinical practice and especially the youngest ages, CVH is considered primarily as a tool to evaluate and promote healthy lifestyle. Formal scoring is optional and clinicians should take care when discussing CVH with the family to emphasize the concepts and the lifelong wellness journey and not the specific score, given the sparsity of data to support a specific scoring framework. Still, many clinicians may find scoring feasible and helpful for their own purposes starting at school-age (~ 6 years), and some may choose to start scoring CVH as young as age 1 to 3 years. For example, short surveys could briefly assess the CVH behaviors prior to the visit and then be combined with vital signs information by nursing staff. This could be used to prepare a CVH score and metric summary report at the start of the visit, which the treating clinician could use to help direct further assessment and counseling. We anticipate that CVH assessment tools and scoring for the youngest children will be an active area of research and future updates, but some initial suggestions for scoring CVH at ages <6 years are provided below. For situations in which fewer than 8 of the component CVH metrics are available or are appropriate for measurement, the writing group suggests using the weighted average of the available metrics (with the denominator representing only the available metrics) to represent the overall composite CVH score.

<u>Diet quality</u>: Suggestions for scoring of diet quality at ages 6 months through 5 years are in the Table below. For ages 2-5 years, a subset of 10 items were selected from the 16-item MEPA used in older children and adults. This strategy simplifies the assessment but keeps it aligned with the MEPA tool used

at older ages. For ages 6 to 23 months, a smaller set of 6 items are suggested, with 5 drawn from the MEPA and the sixth representing the milk source recommended for age by pediatric guidelines.[30-34] Clinical scoring of diet at age <6 months is discouraged because although human milk feeding is optimal at this age, once the decision is made not to breastfeed and maternal milk production ceases, it is not readily modifiable and thus is not a useful topic for health promotion counseling. Counseling can instead focus on promoting breastfeeding and avoiding solid food introduction before 6 months, which is modifiable. As with adult diet/eating pattern scoring, the suggested scoring approaches for ages <6 years are attempts to innovate and push the field to advance our abilities for CVH assessment across the life course.

Suggestion for Scoring of Diet Quality Metric at ages <6 years old

	Age 6-<12mo	**Age 1-<2 years**	**Age 2-5 years**
Optimal (100 pts) ≤	6 pts MEPA score for subset: -veggies ≥1x/day, -fruit ≥1x/day, -whole grain ≥1x/day, -no sweets/SSB, -no fast food, -milk=human milk	6 pts MEPA score for subset: -veggies ≥2x/d, -fruit ≥2x/d, -whole grain ≥2x/d, -no sweets/SSB, -no fast food, -milk=human or cow's milk	10pts MEPA score for subset: -veg ≥2 servings/d, -fruit ≥2 serv/d, -whole grain ≥3 serv/d, -sweets/SSB ≤3 serv/wk, -fast food ≤2x/month, -red or processed meat ≤3 serv/wk, -fish ≥1 serv/wk, -nuts/seeds ≥4 serv/wk, -olive oil ≥1 serv/d, -butter/cream ≤3 serv/wk
Worst (0 pts)	0 pts for MEPA score subset	0 pts for MEPA score subset	0 pts for MEPA score subset
Middle scores	MEPA 5 = 85pt MEPA 4 = 70pt MEPA 3 = 55 pt MEPA 2= 40 pt MEPA 1 = 25 pt MEPA 0 = 0 pt	MEPA 5 = 85pt MEPA 4 = 70pt MEPA 3 = 55 pt MEPA 2= 40 pt MEPA 1 = 25 pt MEPA 0 = 0 pt	Subtract 10 pts from diet score for each 1 pt lower on MEPA 10 items (e.g. MEPA 9 = 90 pt)

<u>Physical activity</u>: Suggestions for scoring of physical activity at ages 1 through 5 years are in the Table below. Based on guidance from the American Academy of Pediatrics (AAP)[35, 36] and the Society of Health and Physical Educators (SHAPE),[37] relevant activity can be at any intensity (light to vigorous) and includes both total active play (e.g., unorganized free play with some body movement) and structured activity (e.g., taking a walk or playing an active game). For simplicity of scoring, total active play is the focus in the Table below. Guidance also exists for ages <12 months, recommending several periods of interactive floor-based play and at least 30 min tummy time per day with no prolonged (>15 min) use of restrictive devices (e.g., high chairs). Counseling should be provided on this guidance but it is not readily quantifiable and clinical scoring suggestions are not provided for age <12 months.

It should be noted that sedentary time is another important aspect of the 24-hour activity cycle, and for young children screen time displaces physical activity, negative impacts sleep, and increases the risk for obesity.[38, 39] The physical activity CVH metric provides an opportunity to assess and counsel on not only active play but also screen time, in accordance with AAP recommendations.[38, 39] Parents of very young children may have an easier time quantifying screen time, which may be done in blocks, as opposed to active play, which is often done more fluidly throughout the day. If scoring of screen time were desired, this could be accomplished by setting AAP recommendations (no screen media other than video-chatting at age <18-24 months; <1 hour of high-quality programming per day at age 2-5 years) as the optimal score, choosing a threshold for the worst score (e.g., >2 hours per day) and distributing scores evenly between. However, for consistency with how activity is scored at older ages, we recommend use of active play for this metric when feasible.

Suggestion for Scoring of Physical Activity Metric at ages <6 years old

	Age 1-5 years
Optimal (100 pts)	Total active play ≥180 min/day, averaged over 7 days*
Worst (0 pts)	0 minutes
Middle scores	Points Minutes 100 ≥180 min 90 150 - 179 80 120 - 149 70 90-119 50 60-89 25 1 – 59 0. 0

*Note: guidelines recommend that total active play include 30 minutes of structured activity for toddlers aged 1-2 years and 60 minutes of structured activity for preschoolers aged 3-5 years.

Nicotine exposure: Secondhand smoke exposure is assessed for all children, and scoring per Table 1 in the main text is applicable at any pediatric age, including <6 years old.

Sleep: Scoring of the sleep metric for ages 4 months to 18 years, as for adults, compares actual sleep duration with guideline-recommended sleep duration for that age. For ages <6 years old, recommended sleep duration ranges are per 24 hours and include naps. Scoring is accomplished for ages 4 months and older as shown in Table 1 in the main text, using age-appropriate optimal sleep durations as follows:[40]

Age 4 mo-11mo, 12-16 hrs per 24 hours
Age 1-2y, 11-14 hrs per 24 hours
Age 3-5y, 10-13 hrs per 24 hrs
Age 6-12y, 9-12 hrs
Age 13-18y, 8-10 hrs

BMI: Weight and length are routinely measured at all pediatric visits from birth onward. For ages 2-5 years, BMI percentiles are routinely calculated and classified as shown in Table 1 in the main text.[41] For ages <2 years, assessment and classification of body size is somewhat more complex. The CDC has recommended use of the WHO weight-for-length (WFL) growth charts to assess body size at age <2 years, with weight-for-length >97.7th percentile indicating high WFL and elevated risk for obesity by

CDC standards in later childhood.[41, 42] More recent studies have compared this classification strategy to the use of WHO BMI growth charts at age <2 years, with BMI >97.7th percentile indicating high BMI, and found that the two are largely comparable or that BMI outperforms WFL for consistency across infancy and prediction of later obesity.[43-45] Thus, either WFL or BMI could be used to assess body size at age <2 years, with WFL more common in practice but BMI offering continuity with BMI older ages. However, the pattern of weight gain also appears to be important, as rapid weight gain in infancy is an important predictor of adverse cardiometabolic health outcomes.[46] Studies have commonly defined rapid weight gain as an increase in the standard deviation score (z-score) of 0.67 or more in the weight measure (e.g., WFL) between serial measures.[47, 48] Thus defined, rapid weight gain across various intervals between birth and age 2 years has been associated with future obesity (e.g., in one study, ORs for young-adult overweight/obesity of ~2-4 for an increase in WFL z-score of ≥0.67 from age 1 month or age 3 months to most later time points [6, 9, 12, 18, and 24 months], and less consistently from birth or age 6 months to later time points).[49] As shown in the Table below, we suggest that at age 6-23 months, scoring of the weight metric may consider both current weight and rate of weight gain, and that at ages 1-6 months, scoring may consider current weight. No scoring suggestion is provided for weight at age <1 month, given the closer attention to daily weight gain at this age. In addition, birthweight is associated with later-life cardiometabolic outcomes,[50] but given that it is no longer modifiable after birth, it is not considered in scoring a child's CVH.

It should be acknowledged that there is controversy regarding the best ways to assess infant weight status and risk for future obesity. We suggest deference to clinician judgment when evaluating individual patients. This is true for all children but especially when considering subgroups not specifically addressed here, such as those who were born small-for-gestational-age or preterm who may have appropriate catch-up growth,[51] or infants and toddlers with low WLF or BMI or slow growth which could also be unhealthy. To reiterate a point made above regarding formal calculation of CVH scores in clinical practice, we suggest that especially at very young ages, the primary use of CVH is as a conceptual framework to discuss healthy lifestyle behaviors. If formal scoring of the weight metric and other metrics is undertaken in very young children, it is likely best used as a screening tool for the clinician rather than a point of discussion with the family.

Suggestion for Scoring of Weight Metric at ages <2 years old

	Age 1-6 months	**Age 6-23 months**
Optimal (100 pts)	WFL or BMI <97.7th percentile	WFL or BMI <97.7th percentile AND increase in WFL or BMI z-score of <0.67 since prior routine visits (e.g., since age 1 month)
Worst (0 pts)	N/A*	WFL or BMI ≥99.7th %ile percentile AND increase in WFL or BMI z-score of ≥0.67 since prior routine visits
Middle scores	WFL or BMI ≥97.7th %ile but <99.7th %ile: score = 75 points WFL or BMI ≥99.7th %ile: score = 50 points	Subtract 25 points if WFL or BMI ≥97.7th %ile but <99.7th %ile Subtract 50 points if WFL or BMI ≥99.7th %ile Subtract 25 points if increase in WFL or BMI z-score of ≥0.67 since prior routine visits (e.g., since age 1 month)

*Given limited data for this age group, it is not recommended that the weight metric receive a score of 0.

Blood Lipids: Although universal measurement of lipids is not recommended until age 9-11 years, pediatric guidelines have provided classification of lipid levels at any age.[28] For non-HDL-C, the recommended CVH lipid metric, interpretation of non-HDL-C does not change with age across childhood, and scoring can be accomplished at any age lipids are measured using the scoring shown in Table 1 in the main text.

Glycemia: Although universal measurement of glycemia is not recommended in childhood, diagnostic criteria (including the use of HbA1c and fasting plasma glucose) are applicable and consistent across all ages from birth to adulthood per American Diabetes Association guidance.[52]

BP: Although universal measurement of BP is only recommended clinically starting at age 3 years, the AAP has provided age, sex, and height-based BP percentiles and classification starting age 1 year.[27] The BP scoring framework in Table 1 in the main text could thus be applied as early as age 1 year, if a reliable BP were measured.

Appendix 3: Example Calculations of Cardiovascular Health

Example 1:

Mrs. A is a 56 year old woman who scored 12 points the MEPA diet score, and who walks briskly for 30 minutes 3 days per week. She never used combustible tobacco. She generally gets 6.5 hours of sleep per night. Her BMI is 31 kg/m^2. Her non-HDL-cholesterol is 136 mg/dL on a statin medication, and her fasting blood glucose is 107 mg/dL. Her average blood pressure on repeat measurements is 135/76 mm Hg on two antihypertensive medications.

Metric	Points
Diet:	80
Physical activity:	80
Nicotine exposure:	100
Sleep health:	70
Body mass index:	30
Blood lipids:	(60-20) = 40
Blood glucose:	60
Blood pressure:	(50 – 20) = 30
Sum:	490

Mrs. A's Baseline Total CVH Score = 490/8 = 61 out of 100 (Moderate CVH)

Mrs. A expresses her desire to lose weight for her son's impending wedding, and she and her doctor agree on a strategy of avoiding fast-food restaurants, increasing fruit and vegetable intake, and committing to 30 minutes of walking daily. After 6 months, she is feeling well and is losing weight. She also notes that she is sleeping better and longer with the physical activity. After 1 year, she scores 15 points on the MEPA diet score. She has continued brisk walking for 30 minutes daily and does intermittent light jogging. She remains a never-smoker. She now sleeps 8 hours nightly on average. Her BMI has fallen to 28 kg/m^2, and her recent laboratory studies reveal a non-HDL-cholesterol of 118 mg/dL on the statin, and a fasting blood glucose of 92 mg/dL. Her recent blood pressure average is 125/72 mm Hg.

Metric	Points
Diet:	100
Physical activity:	100
Nicotine exposure:	100
Sleep health:	100
Body mass index:	70
Blood lipids:	(100-20) = 80
Blood glucose:	100
Blood pressure:	(75 – 20) = 55
Sum:	705

Mrs. A's Follow-Up Total CVH Score = 705/8 = 88 out of 100 (High CVH)

Example 2:

Alex B is a 16 year old boy who scored 4 points on the MEPA diet score. He practices and plays soccer on his high school team, or works out, for two hours almost every day. He occasionally uses vaping products that contain nicotine, including within the last week, and is exposed to secondhand smoke at home. He gets 8 hours of sleep most nights. His BMI is at the 70th percentile for his age. His non-HDL-cholesterol is 140 mg/dL (untreated) and his fasting blood glucose has not been measured. His average blood pressure on repeat measurements is 116/70 mm Hg. Alex's pediatrician calculates his CVH score using the seven available metrics.

Metric	Points
Diet:	25
Physical activity:	100
Nicotine exposure:	(25-20) = 5
Sleep health:	100
Body mass index:	100
Blood lipids:	40
Blood glucose:	-- (Not available)
Blood pressure:	100
Sum:	470

Alex B's Total CVH Score = 470/7 = 67 out of 100 (Moderate CVH)

Example 3:

Mr. C is a 45 year old man who scored 2 points the MEPA diet score, and who has a sedentary job and pursues no leisure-time physical activity. He smoked cigarettes for 20 years but successfully quit 3 years ago. He works the night shift and generally gets 5 hours of sleep daily. His BMI is 38 kg/m^2. His non-HDL-cholesterol is 185 mg/dL untreated. He was diagnosed as having diabetes 1 year ago, and has struggled to control it, with a recent HbA1c of 9.2%. His average blood pressure on repeat measurements is 137/84 mm Hg, on two antihypertensive medications.

Metric	Points
Diet:	0
Physical activity:	0
Nicotine exposure:	50
Sleep health:	40
Body mass index:	15
Blood lipids:	40
Blood glucose:	10
Blood pressure:	(50 – 20) = 30
Sum:	185

Mr. C's Total CVH Score = 185/8 = 23 out of 100 (Low CVH)

Example 4:

Ms. D is a 75 year old woman who scored 15 points on the MEPA diet score, and who walks moderately for 20 minutes every day. She never used combustible tobacco. She generally gets 7 hours of sleep per night. Her BMI is 24 kg/m^2. Her non-HDL-cholesterol is 120 mg/dL (untreated), and her fasting blood glucose is 96 mg/dL. Her average blood pressure on repeat measurements is 132/68 mm Hg on one antihypertensive medication.

Metric	Points
Diet:	100
Physical activity:	90
Nicotine exposure:	100
Sleep health:	100
Body mass index:	100
Blood lipids:	100
Blood glucose:	100
Blood pressure:	(50 – 20) = 30
Sum:	720

Ms. D's Total CVH Score = 720/8 = 90 out of 100 (High CVH)

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